

PATENT  
Atty. Dkt. No. APPM/006303/CPI/COPPER/PJS  
Serial No.: 09/665,370

## REMARKS

This is intended as a full and complete response to the Final Office Action dated November 28, 2005, having a shortened statutory period for response set to expire on February 28, 2006. Please reconsider the claims pending in the application for reasons discussed below.

Claims 1-7, 9-42, and 44-69 remain pending in the application and are shown above. Claims 1-7, 9-42, and 44-69 stand rejected by the Examiner. Claims 11, 15, 23, 30 are amended to clarify the invention and include elements already presented in independent claims 1, 42, and 47, without introducing new matter. Reconsideration of the rejected claims is requested for reasons presented below.

Claims 1-7, 9-31, 33-42, and 44-69 stand rejected under 35 USC § 103(a) as being obvious over *Lopatin et al.* (US Patent No. 6,368,954) in view of *Lopatin et al.* (U.S. 6,174,799). Applicant respectfully traverses the rejection.

*Lopatin et al.* '954 teaches a barrier layer of 20-300 angstroms formed by atomic layer deposition, a pre-seed layer comprising copper formed by atomic layer epitaxy, and a seed layer comprising copper formed by chemical vapor deposition (CVD). *Lopatin et al.* does not teach, show, or suggest depositing of a seed layer, which comprises copper and a metal selected from the group consisting of aluminum, magnesium, zirconium, and combinations thereof, to be deposited over a thin barrier layer which is deposited by atomic layer deposition to a thickness of less than about 50 Å.

*Lopatin et al.* '799 teaches a method depositing a seed layer over a barrier layer, the seed layer comprises a conductive metal material alloyed with a nitrided metal material, having a graded nitrogen content. *Lopatin et al.* '799 does not teach, show, or suggest depositing of a seed layer, which comprises copper and a metal selected from the group consisting of aluminum, magnesium, zirconium, and combinations thereof, to be deposited over a thin barrier layer which is deposited by atomic layer deposition to a thickness of less than about 50 Å.

In addition, the burden for establishing a prima facie case of obviousness falls on the Examiner. See, *MPEP* §2142. A basic requirement of establishing a prima facie

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case of obviousness is that the combination of prior art references must teach or suggest all the claim limitations and that there must be a motivation to combine the teaching of the references. See, *MPEP* §2143. Applicant asserts that the Examiner has failed to show a clear and particular motivation by the skilled artisan to select from the disclosures of *Lopatin et al.* '954. and *Lopatin et al.* '799. On this point, the Federal Circuit has ruled that "[o]ne cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." (*In re Fritch* at 1784). In order to avoid using the Applicant's disclosure as a blueprint to pick and choose certain elements, while ignoring others, the Examiner must supply a clear and particular motivation or suggestion to do so. In the present case, the only suggestion is provided in the Applicant's disclosure and thus hindsight.

The combination of *Lopatin et al.* '954 in view of *Lopatin et al.* '799, alone or in combination, does not teach, show, or suggest depositing a barrier layer by atomic layer deposition, the barrier layer having a thickness less than about 50 Å, depositing a seed layer over the barrier layer, the seed layer comprising copper and a metal selected from the group consisting of aluminum, magnesium, zirconium, and combinations thereof; and then depositing a copper conductive material layer over the seed layer, as recited in claim 1 and claims dependent thereon. The Examiner has yet to show such a suggestion. Similarly, *Lopatin et al.* '954 in view of *Lopatin et al.* '799, alone or in combination, does not teach, show, or suggest depositing a copper alloy seed layer over the barrier layer, wherein the copper alloy seed layer comprises copper and a metal selected from the group consisting of aluminum, magnesium, zirconium, and combinations thereof, and wherein the barrier layer is deposited by atomic layer deposition to a thickness of less than about 50 Å, and then depositing a second seed layer over the copper alloy seed layer, as recited in claim 15 and claims dependent thereon. *Lopatin et al.* '954 in view of *Lopatin et al.* '799, alone or in combination, does not teach, show, or suggest depositing a first seed layer over the barrier layer, wherein the first seed layer comprises a metal selected from the group consisting of aluminum, magnesium, zirconium, and combinations thereof, and wherein the barrier layer is deposited by atomic layer deposition to a thickness of less than about 50 Å, and then

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depositing a second seed layer over the first seed layer, as recited in claim 23 and claims dependent thereon.

In addition, *Lopatin et al.* '954 in view of *Lopatin et al.* '799, alone or in combination, does not teach, show, or suggest the concentration of a metal in a copper alloy seed layer to a concentration between about 0.001 atomic percent and about 5.0 atomic percent. Therefore, *Lopatin et al.* '954 in view of *Lopatin et al.* '799, alone or in combination, does not teach, show, or suggest depositing a copper alloy seed layer over the barrier layer, wherein the copper alloy seed layer comprises copper and a metal in a concentration between about 0.001 atomic percent and about 5.0 atomic percent, the metal selected from the group consisting of aluminum, magnesium, zirconium, and combinations thereof, and wherein the barrier layer is deposited by atomic layer deposition to a thickness of less than about 50 Å, as recited in claim 11 and claims dependent thereon. *Lopatin et al.* '954 in view of *Lopatin et al.* '799, alone or in combination, does not teach, show, or suggest depositing a barrier layer by atomic layer deposition, the barrier layer having a thickness of less than about 20 Å, depositing a copper alloy seed layer over the barrier layer, the copper alloy seed layer comprising copper and a metal in a concentration between about 0.01 atomic percent and 5.0 atomic percent, the metal selected from the group consisting of aluminum, magnesium, zirconium, and combinations thereof; and then depositing a copper conductive material layer over the copper alloy seed layer, as recited in claim 42 and claims dependent thereon. *Lopatin et al.* '954 in view of *Lopatin et al.* '799, alone or in combination, does not teach, show, or suggest depositing a barrier layer by atomic layer deposition, the barrier layer having a thickness less than about 20 Å, depositing a copper alloy seed layer over the barrier layer, the copper alloy seed layer comprising copper and a metal in a concentration between about 0.01 atomic percent and 5.0 atomic percent, the metal selected from the group consisting of aluminum, magnesium, zirconium, and combinations thereof, depositing a second seed layer over the copper alloy seed layer, and then depositing a copper conductive material layer over the second seed layer, as recited in claim 47 and claims dependent thereon.

Further, *Lopatin et al.* '954 in view of *Lopatin et al.* '799, alone or in combination, does not teach, show, or suggest depositing a barrier layer by atomic layer deposition to

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a sidewall coverage of about 50 Å or less. Therefore, *Lopatin et al.* '954 in view of *Lopatin et al.* '799, alone or in combination, does not teach, show, or suggest depositing a barrier layer by atomic layer deposition to a sidewall coverage of about 50 Å or less, and then depositing a seed layer over the barrier layer, the seed layer comprising copper and a metal selected from the group consisting of aluminum, magnesium, zirconium, and combinations thereof, as recited in claim 30 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claims 31-32, 42, and 44-69 stand rejected under 35 USC § 103(a) as being obvious over *Lopatin et al.* '954 in view of *Lopatin et al.* '799, and in further view of *Tsai et al.* (US Patent No. 6,309,964). Applicant respectfully traverses the rejection.

*Lopatin et al.* '954 and *Lopatin et al.* '799 have been discussed above.

*Tsai et al.*, as stated by the Examiner, discloses only a barrier layer of 10-500 angstroms. *Tsai et al.*, does not disclose, suggest or motivate the subject matter as claimed in claims 31-32, 42, and 44-69 or any element lacking in *Lopatin et al.* '954 and *Lopatin et al.* '799, as discussed above. Withdrawal of the rejection is respectfully requested.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the invention as claimed.

Having addressed all issues set out in the office action, Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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